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USE OF HOLLOW GLASS MICROSPHERES IN ORGANOSILICON SYNTACT FOAM PLASTICS

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The use of hollow glass microspheres in syntact foam plastics with organosilicon binders is described. The physicomechanical and thermophysical properties of the heat-insulating materials obtained are investigated.

Syntact foam plastics are hollow microspheres made of various materials and bound by a polymer binder. The first mention of syntact foam plastics dates back to the early 1960s, when they were recognized as some of the best heat-insulating materials for high-speed aircraft [1]. Glass is one of the most promising materials for microspheres, since it combines high thermal stability, substantial mechanical strength, and chemical inertness.

The purpose of the present paper is to study the possibility of using hollow glass microspheres (HGM) in heat-insulating syntact materials with organosilicon binders.

We investigated HGM of grade MSO based on sodium-boron-silicate glass. The HGM batch used in the experiment had the following characteristics: average particle size 2.0×10^{-5} m, particle density 300 kg/m^3 , volume filling coefficient 60%. The organosilicon binders were: heat-resistant lacquer KO 815, which is a solution of polyphenylsiloxane resin (PPS) in toluene, heat resistant lacquer VKL-1, which

is a solution of oligooxyhydride-silmethylene-siloxysilane (OHSMS) in organic solvents, and heat-resistant rubber SKTN-1, which is polydimethyl siloxane (PDMS) with hydroxyl end groups.

Syntact foam plastics were prepared by mixing HGM with organosilicon binders to the consistency of moist sand and subsequently molding samples under a pressure of 0.25 MPa. After molding, the samples were heat-treated according to the regimes given in Table 1.

The samples obtained were tested for strength on an Instron M 1185 tensile-testing machine. Compressive testing of the samples (Fig. 1) showed that the highest strength parameters are exhibited by samples with the OHSMS binder, and the lowest parameters are observed in samples with the PDMS binder. However, it should be noted that samples based on PDMS exhibit considerable reversible deformation (up to 8%) and, accordingly, are most resistant to impact.

The effect of the content of HGM in the foam plastics on the heat resistance was tested on a Paulik – Paulik – Erday derivatograph. It was found that an increasing HGM content in the foam material results in an increasing weight loss in all

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TABLE 1

Composition, %		Temper- ature, K	Duration, h	Foam-plastic apparent den- sity, kg/m^3
HGM	binder (dry residue)			
PDMS*:				
60	40	298	72.0	305
40	60	298	72.0	427
PPS:				
60	40	423	4.0	294
40	60	423	6.0	406
OHSMS:				
60	40	473	3.0	289
40	60	473	4.5	394

* The curing agent was K18 catalyst in an amount of 4% of the binder weight.

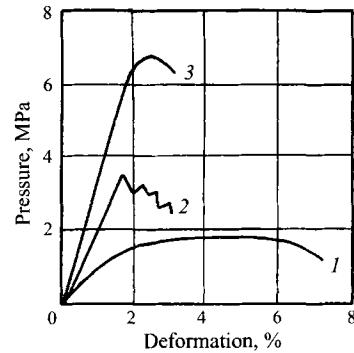


Fig. 1. Effect of the type of binder on the strength parameters of foam plastics with 60% HGM: 1) PDMS; 2) PPS; 3) OHSMS.

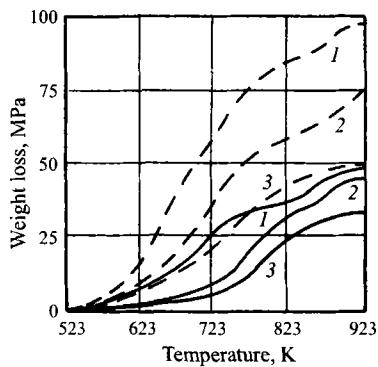


Fig. 2. Weight loss of the binder in the foam plastic: 1) PDMS; 2) PPS; 3) OHSMS; solid curves) 10% HGM; dashed curves) 90% HGM.

the organosilicon binders considered (Fig. 2). This can be attributed to the presence of hydroxyl groups on the microsphere surface, which are centers of depolymerization of high-molecular-weight organosilicon compounds. It is impossible to remove hydroxyl groups by preliminary heating of HGM, since their complete dehydroxylation occurs only at the temperature of their disintegration.

The thermal conductivity of the foam plastics was tested using an IT-λ-400 instrument. An increased content of HGM in the foam plastics improves their heat-insulating parameters (Fig. 3a). The high heat-resistance parameters of the foam plastics with the PDMS binder can be accounted for by the increased chain flexibility in this polymer compared to PPS and OHSMS.

Dilatometric testing of the samples showed that introduction of HGM in significant quantities produces a substantial decrease in the TCLE of the foam material (Fig. 3b).

Based on this investigation, the following conclusions can be drawn:

- the use of HGM will ensure production of heat-insulating materials with high resistance to mechanical actions at substantial service temperatures;

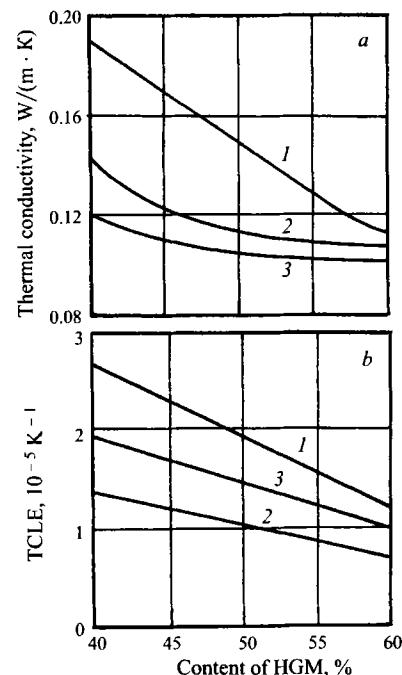


Fig. 3. Thermal conductivity (a) and TCLE (b) versus the HGM content in the foam plastic: 1) PDMS; 2) PPS; 3) OHSMS.

– the use of HGM in organosilicon foam plastics contributes to achieving and controlling optimum thermophysical parameters;

– the use of organosilicon binders of various types makes it possible to obtain foam plastics with required physicomechanical properties.

REFERENCES

1. A. A. Berlin and F. A. Shutov, *Hardened Gas-Filled Plastics* [in Russian], Khimiya, Moscow (1980).